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# Nitrogen Management in Cranberry Systems

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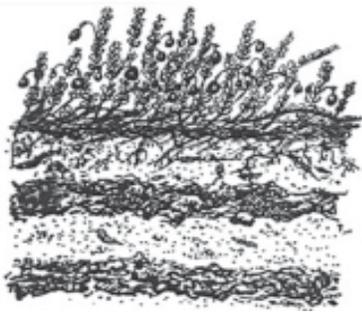
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# BEST MANAGEMENT PRACTICES

## Nitrogen Management in Cranberry Systems

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The single most important nutrient element in cranberry production is nitrogen. Nitrogen is required by cranberry plants for the production of vegetation (new leaves and stems), roots, and fruit (crop). Cranberry plants get nitrogen from the soil, from water (very little), or from added fertilizers.

Approximately 95% of the nitrogen in a given soil that becomes 'plant-available' in a single growing season comes from the decomposition of soil organic matter. Cranberries are grown in either organic soils modified by surface application of sand or in mineral soils. Average organic matter in the surface horizon of Massachusetts cranberry soils is less than 3.5%. The rooting zone typically contains about 95% sand; silt and clay make up less than 3% of the soil.

Nitrogen release from the soil organic matter depends on temperature and soil moisture status. The release process, known as *mineralization*, depends on bacterial activity in the soil. When the soil is waterlogged, the bacteria cannot get enough air to function well. As with many biological reactions, mineralization is also temperature dependent, tending to increase as the soil temperature increases. A second bacterial reaction, *nitrification*, where ammonium is further metabolized to nitrate, may also occur. This second reaction is unfavorable for cranberry production.

Each season, nitrogen is removed during harvest and detashing (removal of fallen leaves from the bog floor). When the fruit is harvested, more than 20 lbs N/A is removed in an average (150 bbl/A) crop. The amount of nitrogen removal increases with increasing crop load and is reduced when crops are small. To compensate for this loss and to supplement natural N release from the soil, cranberry growers add fertilizer to their bogs. Unlike most horticultural crops, cranberries preferentially use ammonium nitrogen. Although cranberries can take up nitrate, this only happens in the presence of ammonium. Further, they have very low activity of the enzyme (nitrate reductase) that converts nitrate into metabolically usable ammonium inside the plant. Thus, it is unlikely that much of the nitrate taken up by cranberries is actually used in the plant. For this reason, fertilizers in which all of the nitrogen comes from ammonium (including urea) are recommended for cranberry production. This also serves to minimize the potential for loss of nitrate to the surrounding environment.

The required amount of added nitrogen fertilizer varies by season, cultivar, and general status (length, color) of the cranberry plants.

### Recommended Practices

◆ ***Soil testing.* Periodically test soil for organic matter content and soil pH.**

Soil should be tested for organic matter content as this material releases nitrogen for use by the cranberry plants. Test soil for organic matter every 2-3 years, always testing the year after sanding. Sandy bogs have less potential for natural N release. As organic matter in the soil increases, less fertilizer N should be used.

Soil pH should be tested at least once every three years (more often if you are attempting to modify pH). As soil pH rises, biological conversion of cranberry-preferred ammonium to less-desirable nitrate increases. This phenomenon is most pronounced in bogs with high organic matter soil. Soil pH on cranberry bogs with soil organic matter content of 0-5% should be between pH 4.0 and 5.0, while soils with organic matter content greater than 5% should have a pH of 4.5 or less.

◆ ***Soil temperature.* Plan nitrogen fertilizer applications based on soil type and temperature. On sandy soils, nitrogen fertilizer may be applied throughout the season. Otherwise, applications should be based on soil temperatures.**

For typical cranberry bogs, applications of N should not be necessary early in the spring. From flood removal until soil temperatures exceed 55°F, adequate N should be available through biological processes. Nitrogen is slowly released from the soil early in the spring when the cranberry plants are dormant (and cannot use N) - this N builds up in the soil. This leads to a 'flush' of ammonium availability early in the spring when the plants are breaking dormancy.

As soil temperatures increase from 55°F to 70°F, release of N from soil organic matter is only moderate. Fertilizer applications then should be beneficial. This corresponds to the period from roughneck stage through bloom.

During spells of hot weather, when soil temperatures exceed 70°F and air temperatures exceed 85°F, soil N release increases and crop development slows, so planned fertilizer N applications should be reduced, delayed, or eliminated.

◆ ***Nitrogen fertilizer rates.***

N requirements differ for different cultivars. Generally 'Stevens' require more N than 'Howes' or 'Early Black'.

Small-fruited cultivars such as Early Black and Howes require the addition of 20-30 lbs N per acre per season. Large-fruited cultivars such as Stevens may require more N, up to 60 lbs N per acre per season. Rates higher than 40 lbs/A should be used with caution as they may lead to excessive vine growth and reduction in fruit quality.

Consistency in management is important for achieving predictable yields. Research has shown that overall N rate in the year *before* a crop may be a more important predictor of yield than N rate in the current season. Further, timing of N application may be even more important than rate.

Excess N leads to over-vegetative plants with long uprights, many runners, and few fruit. Excess vegetative growth may increase susceptibility to disease, spring frost, or insect feeding. High N doses may also lead to poor fruit quality and delay color development in the fruit. High N doses can have adverse carry-over effects in following years as stored excess N is remobilized.

Additional nitrogen fertilizer should be added if the cranberry plants show signs of nitrogen deficiency - poor growth, loss of leaf greenness, and/or low nitrogen content in the leaf tissue.

◆ **Monitoring cranberry plant nitrogen status.**

Tissue testing for %N is used to determine nutrient status of cranberry plants. The standard value for all cultivars in August (recommended testing time) is 0.9-1.1%. Earlier in the season, higher values (up to 1.5%) are normal. As growth dilutes the nitrogen in the plants, %N decreases to approximately 1%. Values below normal may indicate the need for added N fertilizer.

SPAD Chlorophyll Meters may also be used to monitor leaf nitrogen status. The meter readings are used to determine if %N is in the normal range. Use of the Chlorophyll Meter is particularly recommended for monitoring in June and July - one gets instantaneous readings covering the wide range of %N values that can

occur during this period of rapid growth. Old or new leaves may be monitored in June or July, while *only* new leaves should be monitored in August. High readings in *old* leaves in August are likely due to overuse of N fertilizer and are associated with poor crops the **following** year. Reduced N use early the following year may compensate. Meter readings vary by cultivar and year. Average values **below** standard indicate the need for N fertilizer if vegetative growth is normal. Standard **minimum** SPAD values for the **average** of readings in a bed are in the table at the bottom of the page.

Length of new growth can be also be used to indicate nutrient status of cranberry plants *before* early bloom. Adequate growth during this period is highly correlated with high yields. Less than ideal length indicates the need for N fertilizer. From hook stage through early bloom, ideal lengths are as follows:

Early Black	50 - 60 mm	Howes	45 - 55 mm
Ben Lear	55 - 65 mm	Stevens	60 - 70 mm

**For further information:**

**Cranberry chart book - management guide for Massachusetts.** University of Massachusetts Cranberry Experiment Station.

Davenport, J. 1994. **Nitrogen: how fertilizer rates and timing influence cranberry yield and fruit quality.** *Cranberries* 58(2):13-17.

Davenport, J. R. 1993. **Nitrogen: its role and function in cranberry plants.** *Cranberries* 57(8):14-15.

Davenport, J., C. DeMoranville, J. Hart, K. Patten, L. Peterson, T. Planer, A. Poole, and J. Smith. 1995. **Cranberry tissue testing for producing beds in North America.** Fact Sheet. Available from the Cranberry Experiment Station. *or:* *Cranberries* 60(7):11-14.

Provost, J. and J. Davenport. 1994. **The chlorophyll meter as a tool for monitoring cranberry nitrogen needs.** *Cranberries* 58(3):23-25, 27.

<b>SPAD values for cranberry leaves.</b> If average of readings for the bog are <b>below</b> these values and no vine overgrowth is present, add nitrogen fertilizer.						
		Roughneck to hook stage (June)		Bloom to fruit set (July)		Pre-harvest (August)
<u>Cultivar</u>	<u>Leaves:</u>	<u>old</u>	<u>new</u>	<u>old</u>	<u>new</u>	<u>new only</u>
Early Black		40	25	35	35	35
Howes		45	30	40	40	40
Stevens		40	30	35	35	40
Ben Lear		40	25	35	35	40